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Clinical paper

Postcardiac arrest neurological prognostication with quantitative regional cerebral densitometry

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Abstract

Purpose: To quantitatively assess the severity of anoxic-ischemic brain injury early after cardiac arrest (CA) using a novel automated method applied to head computed tomography (HCT).

Methods: Adult patients who were comatose and underwent HCT < 24 h after arrest were included in a retrospective analysis. Principal endpoint was unfavorable outcome (UO) defined as Cerebral Performance Category (CPC) of 3–5 at hospital discharge. We developed an automated processing algorithm for HCT images to be registered, atlas-segmented in 181 regions, and region-specific radiologic densities determined in Hounsfield Units. This approach was compared with an established manual method evaluating grey-white matter ratios (GWR). We tested univariable and multivariable prognostic models which integrated clinical and HCT features including densities in lobes and in nodes of cerebral networks linked to CA recovery.

Results: Ninety-one patients were enrolled among whom 66 (73%) had an UO. HCTs were interpreted as normal or without acute abnormality by a neuroradiologist in 77 cases (85%). Compared to the favorable outcome group, UO patients had significantly lower densities in all lobes and in nodes of cerebral networks. A model combining clinical variables with the automated method applied to cerebral network nodes had the highest prognostic performance although not significantly different than the combined clinical-GWR method (AUC [95% CI] 0.94 [0.86–1.00] and 0.92 [0.83–1.00] respectively).

Conclusion: In comatose survivors of CA, automated quantitative analysis of HCT revealed very early multifocal changes in brain tissue density which are mostly overlooked on conventional neuroradiologic interpretation and are associated with neurological outcome.

Keywords: Anoxic-ischemic encephalopathy, Cardiac arrest, Computed tomography, Neuroimaging, Cerebral networks, Prognostication

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